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melting a steel having the chemical composition as described in claim 3;

casting the molten steel to obtain a steel ingot of a taper $T_p = (D1 - D2) \times 100/H$ of 5.0-25.0%, a height-diameter ratio $R_h = H/D$ of 1.0-3.0, and a flatness ratio $B = W1/W2$ of 1.5 or less, taking the diameter of a corresponding circle with a circumference corresponding to the circumferential length of the top of the steel ingot as $D1$, the diameter of a corresponding circle with a circumference corresponding to the circumferential length of the bottom of the steel ingot as $D2$, the height of the steel ingot as H , the diameter of a corresponding circle with a circumference corresponding to the circumferential length of the steel ingot at a location of $H/2$ as D , and the length of the long side and length of the short side of the steel ingot at a location of $H/2$ as $W1$ and $W2$, respectively;

forging the steel ingot at a forging ratio of at least 4 for a forged piece;

then submitting to soaking treatment by keeping the forged piece one or more times in a temperature range of 1100-1280°C for a total hot holding time of 10-100 hours; and

then plastic working the forged piece to make the size of a nonmetallic inclusion in the steel be 30 μm or less when the size of the nonmetallic inclusion is expressed by the diameter of a corresponding circle taking the circumferential length of the nonmetallic inclusion to be the circumference of the corresponding circle.

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